§48. Establishment of Active Control of Hydrogen Recycling in QUEST

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Recycling and wall pumping properties are crucial issues for density control of a steady state plasma operation in thermonuclear fusion devices. In the case of the steady state operation in the QUEST, it is necessary that hydrogen recycling on the plasma facing materials and the divertor is actively controlled. Therefore, the understanding of hydrogen behavior on the plasma facing materials is the most critical issues as well as the plasma control, and then, absorption and desorption of hydrogen during the plasma discharge on the first wall are controlled from the basis for them. The purpose of the present work is established of active control of hydrogen recycling of tungsten (W) wall in the QUEST.

Behavior of hydrogen in the first wall is depend on incident from the plasma, re-deposition and diffusion/trapping, desorption of hydrogen. Major contributing factors are considered to be (1) property of incident hydrogen (energy and flux, etc.) (2) property of re-deposited layer (crystal structure, composition, microstructure, diffusion/tapping/desorption of hydrogen), (3) behavior of hydrogen in the first wall. In the present work, as the first step, tungsten redepoited layer will be formed as a function of substrate temperature, redeposition rate, ion energy of hydriogen and vacuum pressure (atmosphere gas). Basic behavior concerning micro-structure, trapping/desorption of hydrogen and formation of dust will be systematically investigated.

In the present work of the first year, W re-deposit layer has been formed by physical vapor deposition (PVD). W depositions were prepared by physical vapor deposition in a high vacuum pressure. Figure 1 shows a schematic diagram of deposition device. The vacuum condition and deposition rate of W were adjusted to obtain a deposition ratio comparable to the QUEST case. Pre-thinned (3mm ϕ x 0.1mmt) or bulk W (5 mm x 10 mm x 0.1mmt) specimens were used as substrates. The substrate temperature during vacuum deposition was controlled from room temperature (RT) to 703 K. The deposition thickness was measured by a thickness monitor during the vacuum deposition. In the present work, deposition rate was 0.1 nm/s and redeposit W layer with a thickness of 12nm～20 nm was formed.

Figure 2 shows dark field image(b) and corresponding electron diffraction pattern(a) of the W depositions formed at a substrate temperature of 673 K. The thickness measured by thickness monitor was 79 nm. The images were obtained from a part of the first broad diffraction ring. Under this image condition, only the grains satisfying the Bragg condition are designated as a white contrast. It can be seem that crystal grains size of the depositions formed was around a few nm in diameter. Formation condition of W-deposits has been systematically changed and the dependence for the microstructure has been investigated.

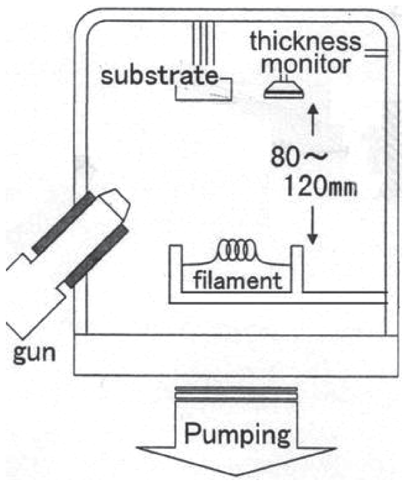

Fig. 1 Schematic diagram of deposition device

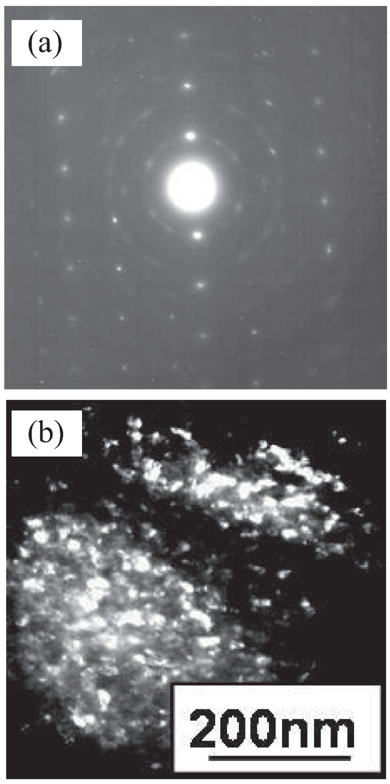

Fig.2 Electron diffraction pattern(a) and microstructure of W(b)